

Applicant appreciates the Examiner's indication that claims 20, 21, 29 and 30 contain allowable subject matter. For the reasons discussed below, Applicant submits that all pending claims are allowable.

The specification is objected to for containing typographical errors. The specification is amended responsive to the objection. It is requested that the objection be withdrawn.

The title is objected to for not being descriptive. The title is amended responsive to the objection. It is requested that the objection be withdrawn.

The drawings are objected to for failing to show a "certain device" recited in claim 31. Applicant submits that a "certain device" is shown, for example, in Figure 1 as reference numerals 17, 18 and 21. It is respectfully requested that the objection be withdrawn.

Claims 1-8, 10, 25 and 33 are rejected under 35 U.S.C. §112, first paragraph. Specific language in claims 1 and 25 is identified as forming the basis for the rejection. Applicant submits that changing a structural condition of the image pattern is described, for example, on page 47, lines 13-23 of Applicant's specification. It is respectfully requested that this rejection be withdrawn.

Claims 1-8, 10, 11, 25 and 33 are rejected under 35 U.S.C. §112, second paragraph. Specific language in claims 1, 11 and 25 is identified as forming the basis for the rejections. Applicant respectfully submits that changing the illumination condition for illuminating the pattern, refers, for example, to rotating a diaphragm adjusting plate. A description of changing the illumination condition for illuminating the pattern is provided for example, on page 23, line 22 to page 24, line 10 of the specification. Thus, changing the illumination condition for illuminating the pattern, as recited in claim 1 and as similarly recited in claim 25, is different from changing a wavelength of illumination light.

With regard to claim 11, page 3 of the Office Action states that it is unclear as to what is meant by "the installation environment of the assembly location" because according to

claim 4, the installation environment is different from the assembly location. Applicant amended claim 4 to recite "an environment of the assembly location" and "an environment at the relocated location" in order to more clearly recite the features of the claim. Applicant also amended claim 11 to recite "environment" instead of "installation environment" in view of the amendment to claim 4, from which claim 11 depends. It is respectfully requested that the rejection be withdrawn.

Claims 1-3, 5-8, 12-14, 17-19, 22-26, 31-33 and 35 are rejected under 35 U.S.C. §102(a) over Shinonaga et al. (hereinafter "Shinonaga"), U.S. Patent No. 5,838,426, and claims 4, 10, 11, 15, 16, 27, 28 and 34 are rejected under 35 U.S.C. §103(a) over Shinonaga. The rejections are respectfully traversed.

Applicant submits that Shinonaga fails to disclose an adjustment method for a projection optical system ... comprising changing at least one condition of illumination condition for illuminating the pattern on the first surface and structural condition of the pattern in various ways, changing a wavelength of illumination light for illuminating the pattern on the first surface for each condition, and detecting a change amount of image formation characteristics of an image projected onto the second surface via the projection optical system, as recited in claim 1. Similarly, Shinonaga fails to disclose a projection exposure apparatus comprising an illumination optical system ..., the apparatus comprising ... a control system which is electrically connected to the wavelength adjusting device and the image formation characteristics measurement system, changes at least one condition of illumination condition for illuminating the mask pattern and structural condition of the mask pattern in various ways, controls the formation characteristics measurement system to measure a change amount of the image formation characteristics while changing the wavelength by the wavelength adjusting device for each condition, and determines a predetermined relationship between a change amount of the installation environment of the

projection optical system and the change amount of the image formation characteristics based on the measurement results for the each condition, as recited in claim 25.

Shinonaga discloses measuring the pressure every time wafers are to be loaded into the projection exposure apparatus, adjusting the wavelength for the exposure process based on the result of the pressure measurement, and performing the exposure process with the adjusted wavelength in order to improve image performance (col. 10, lines 1-8). In addition, Shinonaga discloses a projection exposure apparatus equipped with an adjusting mechanism for correcting a difference in magnification between different processes, or for correcting an error in magnification between different apparatus when different processes are performed with different apparatus (col. 10, lines 9-15). Thus, Shinonaga discloses adjusting the wavelength, correcting a difference in magnification or correcting an error in magnification based on certain specified conditions (i.e., change in pressure, when there is a difference in magnification between different processes or when different processes are performed with different apparatus). Thus, Applicant submits that Shinonaga fails to disclose all the features of claims 1 and 25.

With regard to claims 12 and 26, Applicant submits that Shinonaga fails to disclose an exposure method for illuminating a pattern formed on a first surface by an illumination light and projecting an image of the pattern onto a second surface via a projection optical system, comprising ... a second step of selecting at least one of a first technique for adjusting the predetermined image formation characteristics by changing a wavelength of the illumination light and a second technique for adjusting the predetermined image formation characteristics using a method different from the first technique, and a third step of correcting the change amount of the predetermined image formation characteristics caused by the predetermined factor using the at least one selected technique in the second step, as recited in claim 12. Similarly, Applicant submits that Shinonaga fails to disclose a projection exposure apparatus

comprising an illumination optical system ... and a projection optical system ..., the projection exposure apparatus comprising a first image formation characteristics adjustment system which is electrically connected to the measurement device and adjusts the predetermined image formation characteristics by a first technique for changing a wavelength of the illumination light, and a second image formation characteristics adjustment system which is electrically connected to the measurement device and adjusts the predetermined image formation characteristics by a second technique which is different from the first technique, wherein at least one of the first image formation characteristics adjustment system and the second image formation characteristics adjustment system is selected, and the at least one selected system is used to correct the change amount of the predetermined image formation characteristics caused by the predetermined factor, as recited in claim 26.

As discussed above with regard to claims 1 and 25, Shinonaga discloses measuring the pressure every time wafers are to be loaded into the projection exposure apparatus, adjusting the wavelength for the exposure process based on the result of the pressure measurement, and performing the exposure process with the adjusted wavelength in order to improve image performance (col. 10, lines 1-8). In addition, Shinonaga discloses a projection exposure apparatus equipped with an adjusting mechanism for correcting a difference in magnification between different processes, or for correcting an error in magnification between different apparatus when different processes are performed with different apparatus (col. 10, lines 9-15). Thus, Shinonaga discloses adjusting the wavelength, correcting a difference in magnification or correcting an error in magnification based on certain specified conditions (i.e., change in pressure, when there is a difference in magnification between different processes or when different processes are performed with different apparatus). Nowhere does Shinonaga disclose or suggest a step of selecting at least one of the first image formation characteristics adjustment system and the second image

formation characteristics adjustment system and using the at least one selected system to correct the change amount of the predetermined image formation characteristics caused by the predetermined factor, as recited in claims 12 and 26.

With regard to claims 22 and 31, Shinonaga fails to disclose an exposure method ..., comprising measuring an installation environment of the projection optical system to determine a change amount of the installation environment, and changing a wavelength of the illumination light according to the change amount of the installation environment while the projection exposure apparatus is executing a predetermined preparation operation for projecting the image of the pattern onto the second surface, as recited in claim 22. Similarly, Shinonaga fails to disclose a projection exposure apparatus comprising ... a projection optical system which projects the image of the mask pattern onto a substrate, the projection exposure apparatus comprising a wavelength adjusting device which changes a wavelength of the illumination light, and an installation environment measurement system which measures the installation environment of the projection optical system and determines a change amount of the installation environment, wherein the wavelength adjusting device changes the wavelength of the illumination light according to the change amount of the installation environment while the projection exposure apparatus is executing a predetermined preparation operation for projecting the image of the pattern onto the substrate, as recited in claim 31.

Shinonaga fails to disclose that the wavelength adjusting device changes the wavelength of the illumination light according to the change amount of the installation environment. Shinonaga merely states that pressure measurement is performed when wafers to be processed are loaded into the projection exposure apparatus (col. 10, lines 1-3). Further, Shinonaga discloses reticle driving means (3) and wafer driving means (11) which operate to move the reticle chuck (2) and the wafer chuck (10), respectively, in order to

prepare for projection of the image of the pattern on the reticle onto the wafer. Nowhere does Shinonaga disclose or suggest that changing of the wavelength occurs during the preparation process. Thus, Applicant submits that Shinonaga fails to disclose all the features of claims 22 and 31.

With regard to claim 4, Applicant submits that Shinonaga fails to disclose an adjustment method for a projection optical system which projects an image of a pattern on a first surface onto a second surface, in which, when assembling and adjusting the projection optical system at an assembly location in case an environment of the assembly location where the projection optical system is assembled and adjusted is different from an environment of a relocated location where the projection optical system is used, changing a wavelength of an illumination light for illuminating the pattern on the first surface from a predetermined wavelength in an amount according to the environment of the relocated location in advance, and then assembling and adjusting the projection optical system under a condition of the changed wavelength, and setting the wavelength to the predetermined wavelength when the projection optical system is used in the relocated location, as recited in claim 4.

The claim 4 method is advantageous because it permits the system to be appropriately assembled and adjusted at an assembly location that is different (environmentally) from "relocated" location where the system ultimately will be used, while accounting for environmental differences between these two locations.

Shinonaga discloses that assembly and adjustment of the exposure apparatus is performed to assure optimal image performance with respect to a reference wavelength of exposure light to be used and with respect to a particular reference pressure at the location where the assembling and adjustment operation is performed. After shipment and after the exposure apparatus is installed at a location where the apparatus is to be used, the exposure wavelength is changed to set a reference wavelength in connection with that location, on the

basis of a difference in pressure corresponding to the difference in land level between that location and the location where the assembling and adjustment was performed (col. 9, lines 56-67). Thus, in Shinonaga, the image performance is controlled by changing the wavelength at the location where the apparatus is used rather than at the location where the apparatus is assembled and adjusted. Accordingly, the optimal wavelength (i.e., a predetermined wavelength) for exposing substrates may not be used at the installation location. Shinonaga fails to disclose changing a wavelength of an illumination light for illuminating the pattern on the first surface from a predetermined wavelength in an amount according to the environment of the relocated location in advance, and then assembling and adjusting the projection optical system under a condition of the changed wavelength, and setting the wavelength to the predetermined wavelength when the projection optical system is used in the relocated location, as recited in claim 4.

For at least these reasons, Applicant submits that Shinonaga fails to disclose or suggest all the features of the pending claims. It is respectfully requested that the rejections be withdrawn.

In view of the foregoing, Applicant submits that this application is in condition for allowance. Favorable consideration and prompt allowance are earnestly solicited.

Should the Examiner believe anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact Applicant's undersigned attorney at the telephone number set forth below.

Respectfully submitted,



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Attachments:

Appendix
Petition for Extension of Time
Amendment Transmittal

Date: March 20, 2003

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<p>DEPOSIT ACCOUNT USE AUTHORIZATION Please grant any extension necessary for entry; Charge any fee due to our Deposit Account No. 15-0461</p>
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APPENDIX

Changes to Title:

The following is a marked-up version of the amended title:

IMAGE FORMATION CHARACTERISTICS ADJUSTMENT METHOD FOR
PROJECTION OPTICAL SYSTEM

Changes to Specification:

Page 9, lines 1-17:

In this case, if the change amount $k5 \cdot \Delta\lambda$ of the relative refractive index n_r in the formula (A4) is equal to the change amount $k4 \cdot \frac{\Delta P}{\Delta n_r}$ of the relative refractive index n_r in the formula (A3), then the optical path of the illumination light when only the wavelength λ is changed for $\Delta\lambda$ is equal to the optical path 52A when only the barometric pressure is changed for ΔP . This is the above mentioned equivalency. The condition when this equivalency is established is approximately as follows.

Changes to Claims:

Claims 36-42 are added.

The following is a marked-up version of each amended claim:

4. (Twice Amended) An adjustment method for a projection optical system which projects an image of a pattern on a first surface onto a second surface, comprising:
- when assembling and adjusting the projection optical system at an assembly location, in case an environment of the assembly location where the projection optical system is assembled and adjusted is different from an environment of a relocated location where the projection optical system is used,
- changing the a wavelength of the an illumination light for illuminating the pattern on the first surface from a predetermined wavelength by an amount according to the installation environment of the relocated location in advance, and then assembling and

adjusting the projection optical system under a condition of the changed wavelength; and
setting the wavelength to the predetermined wavelength when the projection
optical system is used in the relocated location ~~when assembling and adjusting the projection~~
~~optical system at the assembly location in case that installation environment is different~~
~~between an assembly location where the projection optical system is assembled and adjusted~~
~~and a relocated location where the projection optical system is used.~~

11. (Twice Amended) The adjustment method for a projection optical system according to Claim 4, wherein when the projection optical system is used in the relocated location, the wavelength of the illumination light ~~when the projection optical system is used in the relocated location~~ is set to a wavelength according to the ~~installation~~ environment of the assembly location.

12. (Twice Amended) An exposure method for illuminating a pattern formed on a first surface by an illumination light and projecting an image of the pattern onto a second surface via a projection optical system, comprising:

a first step of determining information on a change amount of predetermined image formation characteristics of the projection optical system caused by a predetermined factor; and

a second step of ~~correcting the change amount of the predetermined image formation characteristics using~~ selecting at least one of a first technique for adjusting the predetermined image formation characteristics by changing a wavelength of the illumination light ~~and~~ and a second technique for adjusting the predetermined image formation characteristics using a method different from the first technique; and

a third step of correcting the change amount of the predetermined image formation characteristics caused by the predetermined factor using at least one of the at least one selected technique in the second step.

13. (Twice Amended) The exposure method according to claim 12, wherein in the first step, the change amount of the predetermined image formation characteristics is determined based on the result of measurement of ~~the~~ an installation environment of the projection optical system.

20. (Twice Amended) The exposure method according to Claim 19, wherein in the second step, both the first technique and the second technique are selected, and in the ~~second~~ third step, the residue of the change amount of the predetermined image formation characteristics which the first technique could not completely correct is corrected by the second technique after executing the first technique.

21. (Twice Amended) The exposure method according to Claim 13, wherein when the change amount of the installation environment is greater than or equal to a predetermined value, ~~or more, the change amount of the predetermined image formation characteristics is corrected using the first technique~~ is selected in the second step.

22. (Twice Amended) An exposure method using a projection exposure apparatus for illuminating a pattern formed on a first surface by an illumination light and projecting an image of the pattern onto a second surface via a projection optical system, comprising:

measuring an installation environment of the projection optical system to determine a change amount of the installation environment, and

changing a wavelength of the illumination light according to the change amount of the installation environment ~~when~~ while the projection exposure apparatus is executing a predetermined preparation operation for projecting the image of the pattern onto the second surface.

26. (Twice Amended) A projection exposure apparatus comprising:
————— an illumination optical system which illuminates a mask pattern by an illumination light; and

_____a projection optical system which projects the image of the mask pattern onto a substrate; the projection exposure apparatus comprising:

_____a measurement device which determines information on a change amount of predetermined image formation characteristics of the projection optical system caused by a predetermined factor;

_____a first image formation characteristics adjustment system which is electrically connected to the measurement device and adjusts the predetermined image formation characteristics by a first technique for changing a wavelength of the illumination light; and

_____a second image formation characteristics adjustment system which is electrically connected to the measurement device and adjusts the predetermined image formation characteristics by a second technique which is different from the first technique,

wherein at least one of the first image formation characteristics adjustment system and the second image formation characteristics adjustment system is selected, and at least one of the at least one selected system is used to correct the change amount of the predetermined image formation characteristics caused by the predetermined factor.

29. (Twice Amended) The projection exposure apparatus according to Claim 28, wherein the projection exposure apparatus selects both the first image formation characteristics adjustment system and the second image formation characteristics adjustment system, and allows the second image formation characteristics adjustment system ~~adjusts to~~ adjust the residue of the change amount of the predetermined image formation characteristics which the first image formation characteristics adjustment system could not correct.

30. (Twice Amended) The projection exposure apparatus according to Claim 26, wherein the measurement device determines the change amount of the installation of the projection optical system as the information, and when the change amount of the installation

environment is a predetermined value or more, ~~the predetermined image formation characteristics are adjusted using the projection apparatus selects~~ the first image formation characteristics adjustment system.

31. (Twice Amended) A projection exposure apparatus comprising:
- _____an illumination optical system which illuminates a mask pattern by an illumination light; and
 - _____a projection optical system which projects the image of the mask pattern onto a substrate; the projection exposure apparatus comprising:
 - a wavelength adjusting device which changes a wavelength of the illumination light; and
 - an installation environment measurement system which measures the installation environment of the projection optical system and determines a change amount of the installation environment; ~~and~~
 - ~~a certain device which executes a predetermined preparation operation for projecting the image of the pattern onto the substrate;~~
- wherein the wavelength adjusting device changes the wavelength of the illumination light according to the change amount of the installation environment ~~when the certain device~~ while the projection exposure apparatus is executing the a predetermined preparation operation for projecting the image of the pattern onto the substrate.